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(54) **SYRINGE FOR MIXING AND DISPENSING
ADIPOSE TISSUE**

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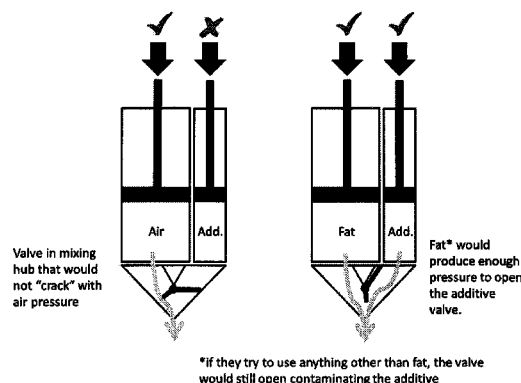
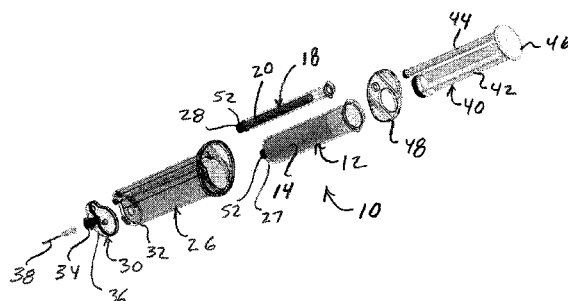
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(57) **ABSTRACT**

A device is provided for introducing into a patient a combi-
nation of adipose tissue and an additive, for example, a hydro-
gel additive. The device includes a fat cartridge, an additive
cartridge containing an additive, and a housing configured to
receive, in a side-by-side manner, the fat cartridge and addi-
tive cartridge. A mixing tip may be included for causing
mixing of the cartridge components prior to extrusion from a
needle or cannula.

9 Claims, 6 Drawing Sheets



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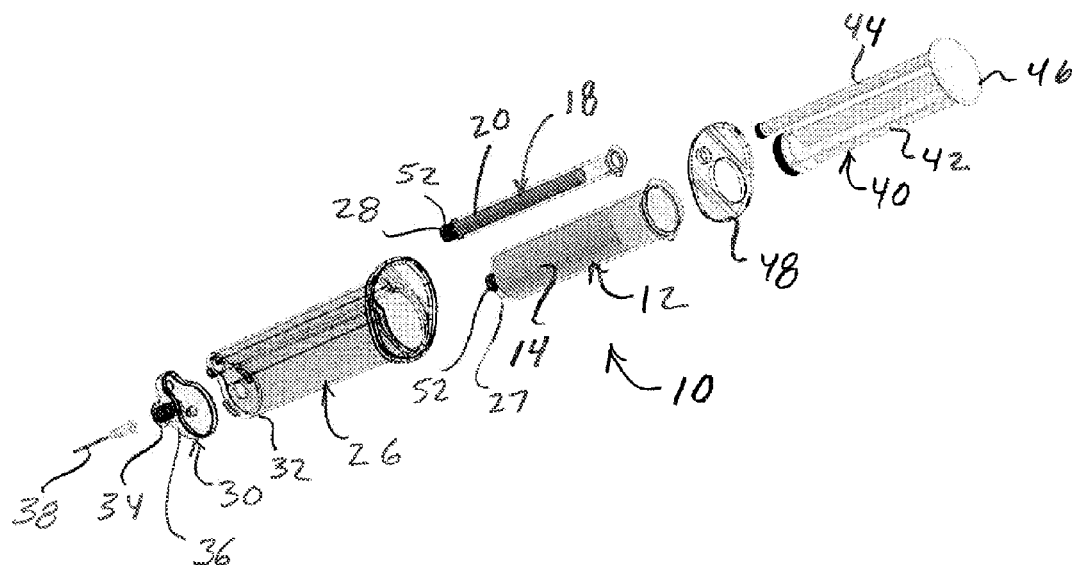


FIG. 1

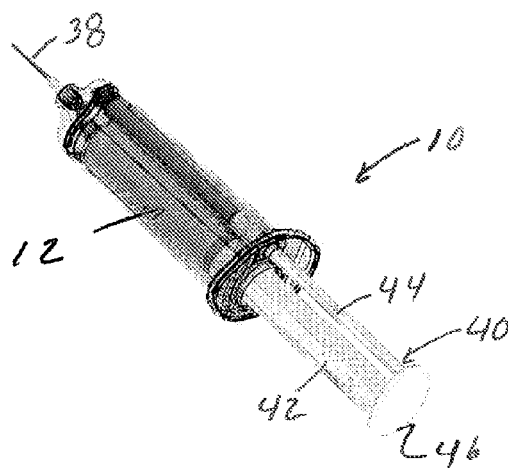


FIG. 2

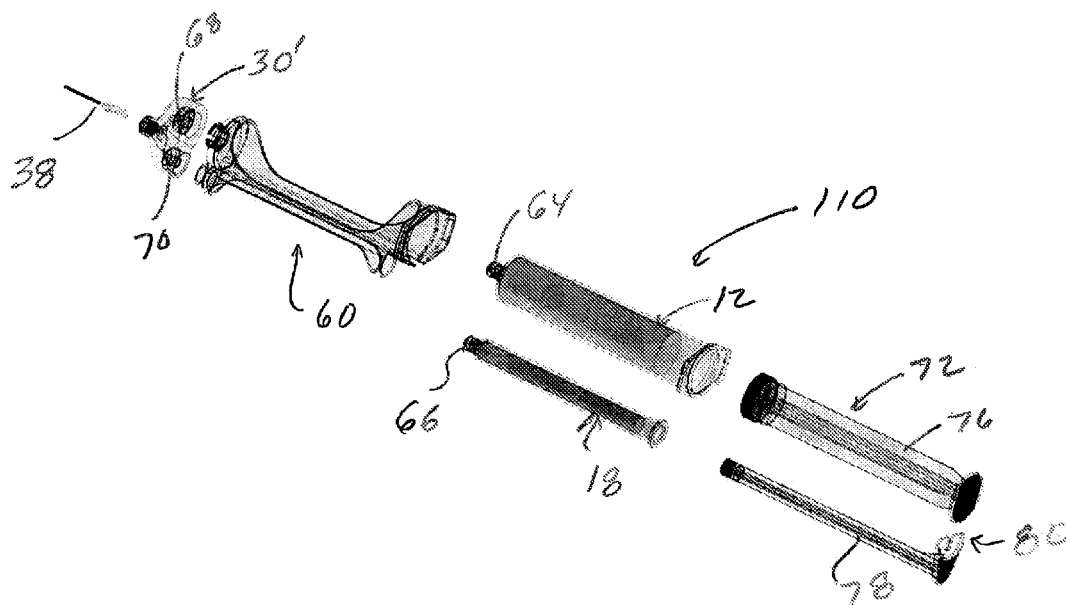


FIG. 3

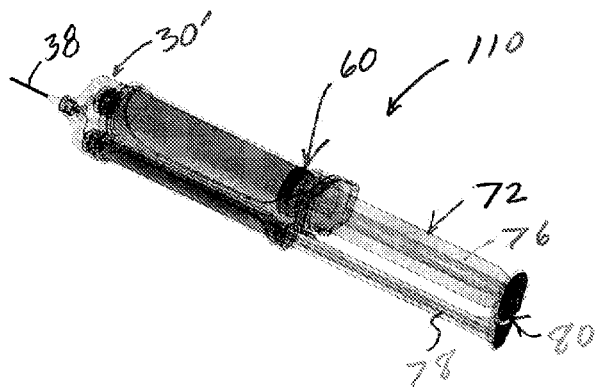


FIG 4

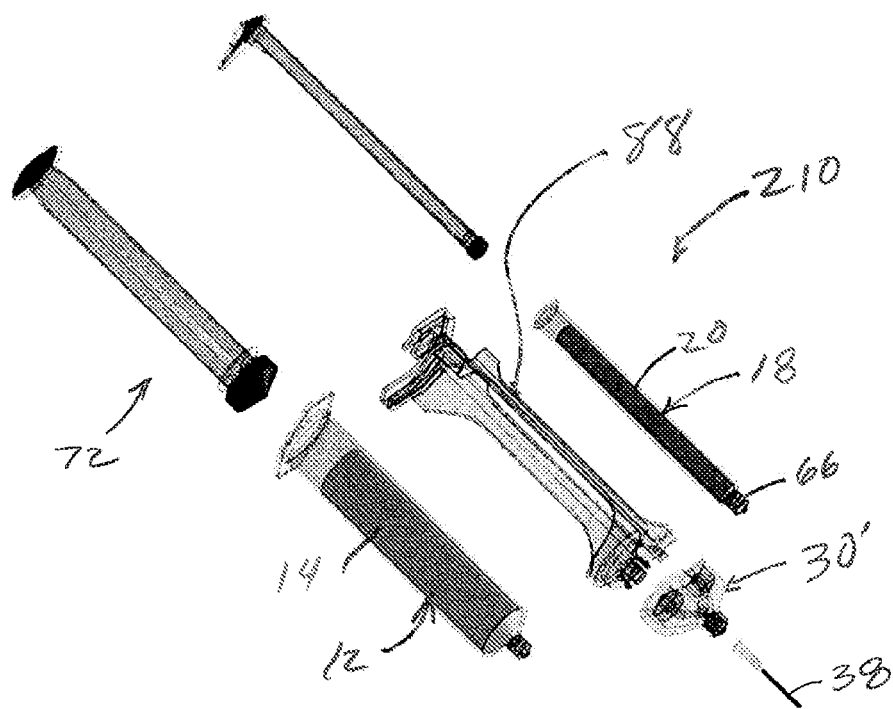


FIG. 5

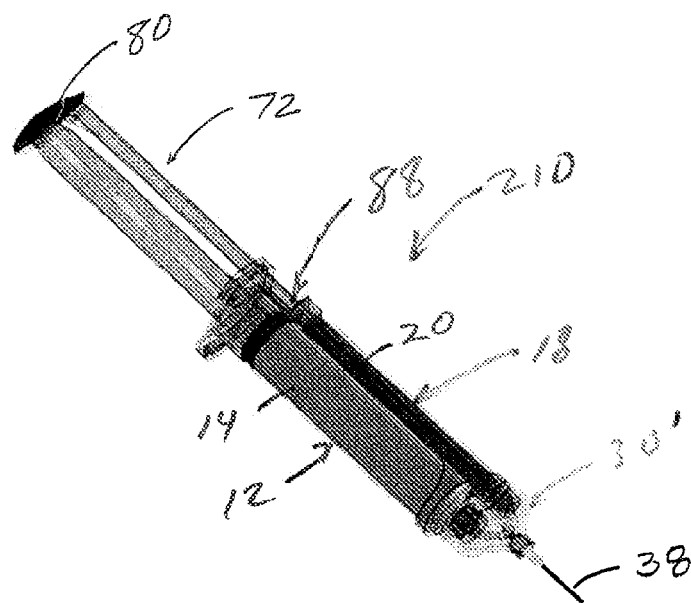


FIG. 6

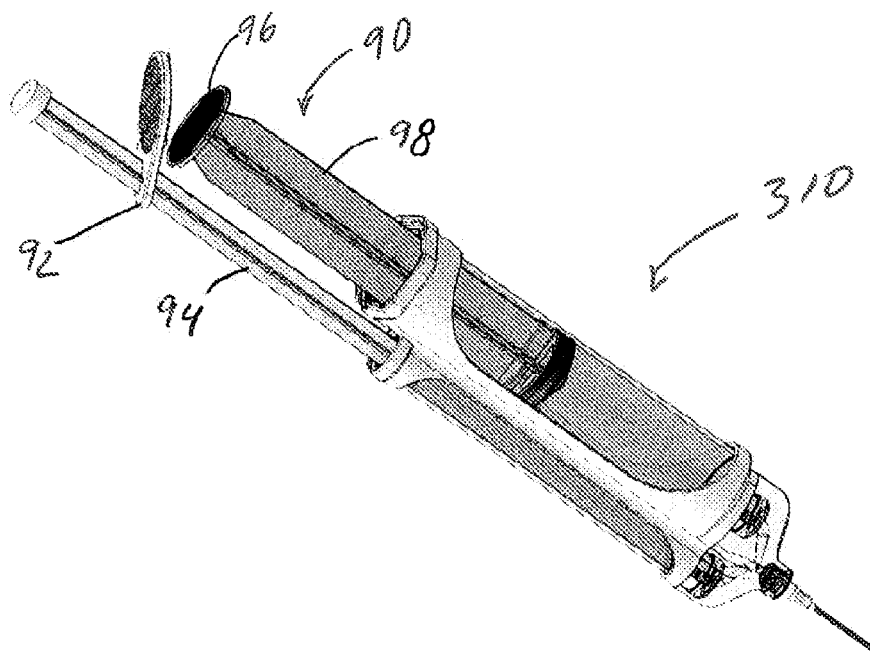


FIG. 7

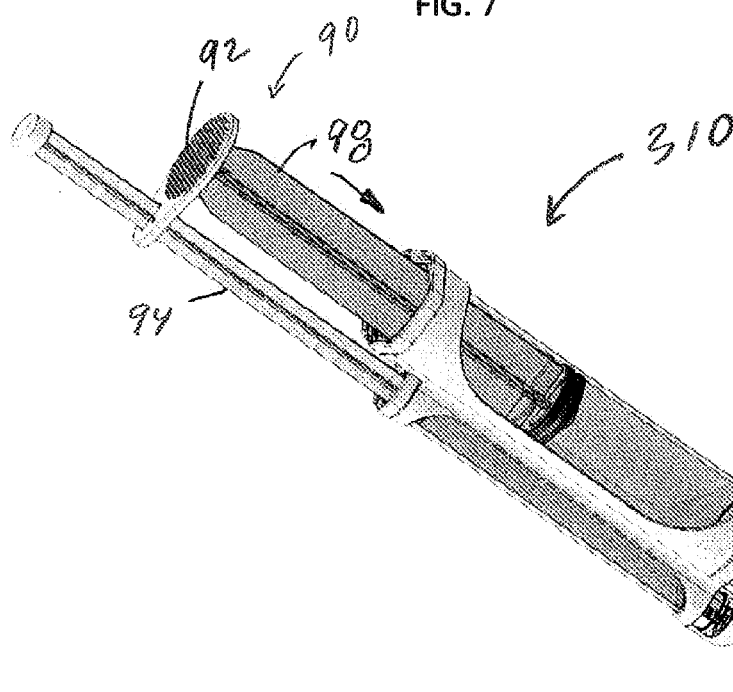
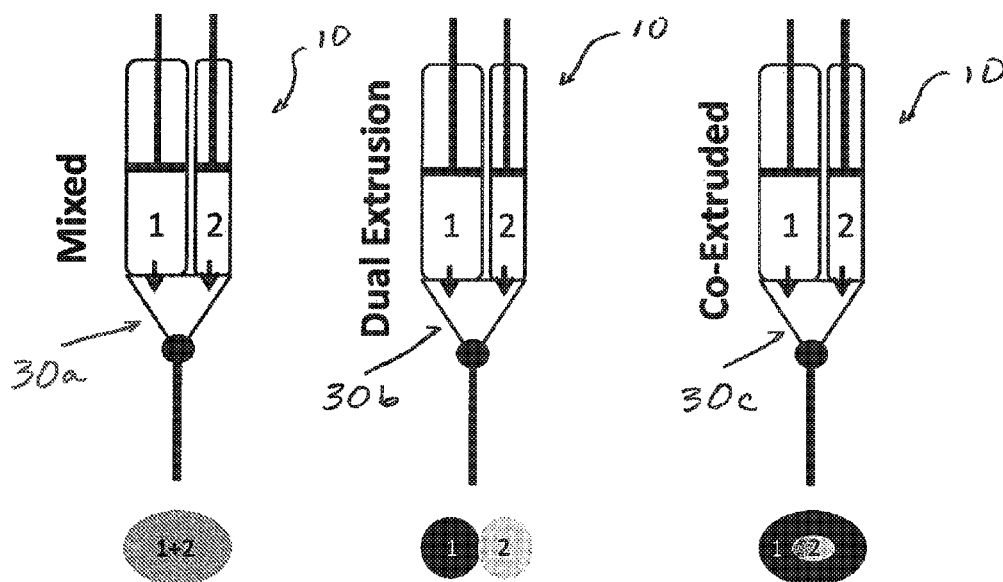


FIG. 8



1 = Fat; 2 = Additive (in an alternative embodiment, these could be switched)

FIG. 9

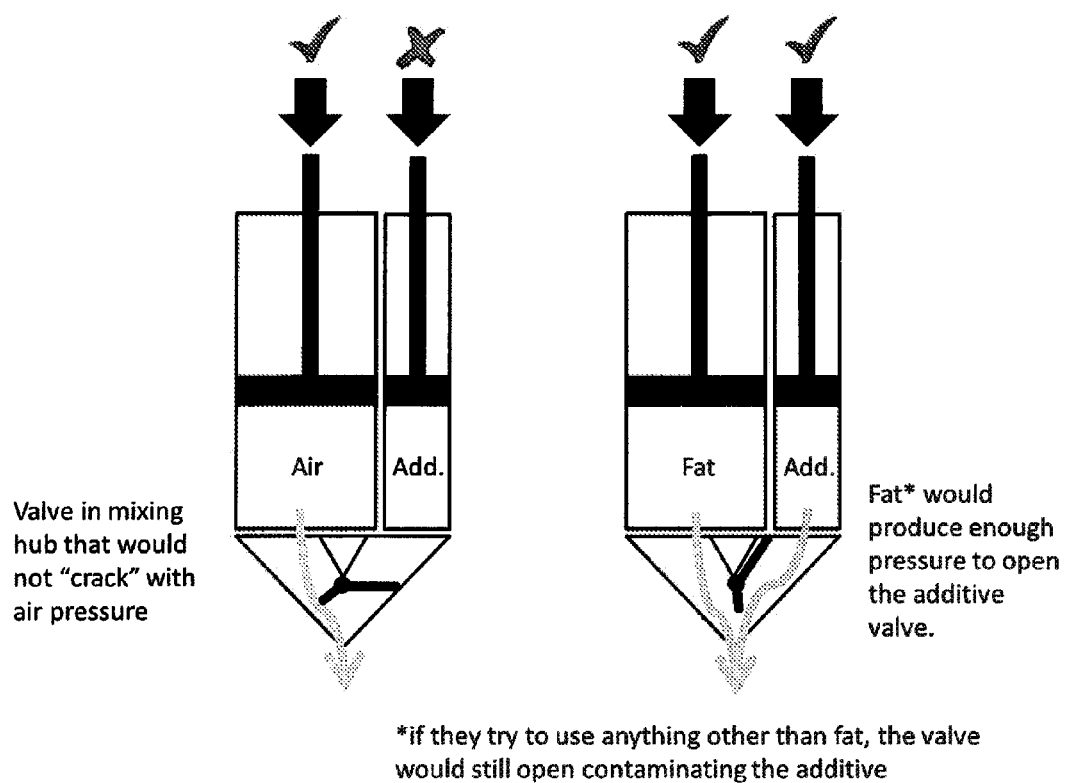


FIG. 10

SYRINGE FOR MIXING AND DISPENSING ADIPOSE TISSUE

This application claims priority to U.S. Provisional Patent Application No. 61/683,157, filed Aug. 14, 2012 the entire contents of which is incorporated herein by reference.

The present invention generally relates to fat grafting procedures and more specifically relates to devices and methods for combining and dispensing adipose tissue and biocompatible additives for use in fat grafting procedures.

Autologous fat transfer (AFT), also known as fat grafting, is a process by which fat is harvested from one part of a human body and injected into another part of the same person's body where additional bulk may be needed or desired for cosmetic and/or aesthetic purposes. Clinical applications for autologous fat transfer are expanding rapidly with recent reported use in breast reconstruction and augmentation, buttock enhancement, treatment of congenital tissue defects, facial reconstruction, and skin rejuvenation. Although this is a very attractive approach and there is an increased trend in replacement of soft tissue volume with AFT, typical survival rates of grafted fat may be poor and overall results may not be satisfactory.

U.S. Patent Application Publication No. 20110202014 discloses a fat graft syringe assembly for delivering small amounts of fat graft material to treat delicate anatomical areas.

WO 2008148071 discloses kits, tools, and methods are described for harvesting, processing, and using injectable dermis in volume filling procedures.

WO 200903135 discloses system for harvesting fat through liposuction, concentrating the aspirate so obtained, and then re-injecting the concentrated fat into a patient.

There still remains a need for improved devices and methods for use in fat grafting procedures.

SUMMARY

Accordingly, a device for introducing into a target region of a patient, a combination of adipose tissue and an additive, is provided. The device generally comprises a fat cartridge for containing an amount of processed or unprocessed adipose tissue or adipose derived material, and an additive cartridge for containing an additive to be combined with the adipose material. The device further comprises a housing configured to receive, for example, in a side-by-side manner, the fat cartridge and additive cartridge, and a mixing tip on the housing, the mixing tip including a distal end for receiving a cannula or needle. The device further comprises a plunger assembly including a fat cartridge plunger and an additive cartridge plunger, configured to be slidably received in the fat cartridge and the additive cartridge, respectively, and for applying force to the contents of the respective cartridges for moving the contents into the mixing tip and eventually out of the cannula or needle.

In some embodiments, the fat cartridge plunger and the additive cartridge plunger are fixed with respect to each other, for example, at a proximal end of the plunger assembly.

In some embodiments, the housing is configured to receive the fat cartridge and the additive cartridge in a longitudinally slidable manner. In other embodiments, the housing is configured to receive the fat cartridge and the additive cartridge in a lateral manner.

In one aspect of the invention, the device further comprises a mechanism for preventing extrusion of additive from the additive cartridge without coextrusion of fat from the fat cartridge.

In another aspect of the invention, a device is provided for administering a formulation comprising an adipose tissue and an additive wherein the device generally comprises (a) a first cartridge for containing an adipose tissue, (b) a second cartridge for containing an additive to be added to and mixed with the adipose tissue and (c) a housing configured to substantially enclose in a side-by-side manner the first and the second cartridges. In addition, the device comprises (d) a mixing tip on the housing, wherein the mixing tip includes (i) a chamber or lumen, (ii) a proximal end for receiving and conducting into the lumen the adipose tissue and the additive for mixing within the lumen, and (iii) a distal end for receiving a cannula or needle through which the formulation can be administered. Further still, the device may comprise (e) a plunger assembly including a first cartridge plunger and a second cartridge plunger, the plunger assembly configured to be slidably received in the first cartridge and in the second cartridge and the plunger assembly when actuated acting to push the adipose tissue, by the action of the first cartridge plunger, from the first cartridge into the lumen and to push the additive, by the action of the second cartridge plunger, from the second cartridge into the lumen, for the mixing therein.

Each and every feature described herein, and each and every combination of two or more of such features, is included within the scope of the present invention provided that the features included in such a combination are not mutually inconsistent.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be more clearly understood and the advantages thereof better appreciated by considering the below Detailed Description and accompanying Drawings of which:

FIG. 1 is a perspective, exploded view of a device in accordance with one embodiment of the invention;

FIG. 2 is a perspective view of the device of FIG. 1, in a fully assembled condition.

FIG. 3 is a perspective, exploded view of another device in accordance with another embodiment of the invention;

FIG. 4 is a perspective view of the device of FIG. 3, in a fully assembled condition.

FIG. 5 is a perspective, exploded view of another device in accordance with yet another embodiment of the invention;

FIG. 6 is a perspective view of the device of FIG. 5, in a fully assembled condition;

FIGS. 7 and 8 are perspective views of yet another device in accordance with another embodiment of the invention, including an adjustable thumb piece loose for positioning (FIG. 7) and engaged (FIG. 8).

FIG. 9 shows simplified views of a device of the invention including a variety of different mixing tips; and

FIG. 10 is a simplified diagram of a feature of the invention for preventing misuse thereof.

DETAILED DESCRIPTION

Referring now to FIGS. 1 and 2, in the shown embodiment, a dual cartridge syringe device, for injection of fat with an additive into the body is provided. The device 10 is generally structured to mix freshly harvested and/or processed fat with an additive for improved viability as it is injected into a patient, for example, for breast augmentation, body contouring, dermal filling, reconstructive purposes, or the like.

The device 10 generally comprises a first cartridge 12, hereinafter sometimes referred to as a fat cartridge 12, for containing an amount of processed or unprocessed adipose

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tissue or adipose derived material, and a second cartridge **18**, hereinafter sometimes referred to as an additive cartridge **18**, for containing an additive **20** to be combined with the adipose tissue **14**.

The adipose tissue may be in the form of freshly harvested or processed lipoaspirate, including adipocytes, adipose-derived stem cells, stromal vascular fraction cells, or combinations thereof.

Additives useful in within the scope of the present devices may be any material that may be mixed with cellular material, for example, living cells, for example, adipose tissue including adipose cells, and which is beneficial to maintaining the viability of the cellular material when mixed therewith and then injected or implanted in a body. Such additives may be in the form of hydrogels that enhance, promote or support cell proliferation or survival. Additives useful in the present devices are described, for example, in commonly owned U.S. Provisional Patent Application No. 61/586,589, filed on Jan. 13, 2012, and entitled CROSSLINKED HYALURONIC ACID-COLLAGEN MATRICES FOR IMPROVING TISSUE GRAFT VIABILITY AND SOFT TISSUE AUGMENTATION, and U.S. patent application Ser. No. 13/740,712, filed on Jan. 14, 2013, the entire disclosure of each of these documents being incorporated herein by this reference.

When injected or implanted in vivo, the hydrogel or a hydrogel composition may promote cell and/or tissue growth, including growth into the implant material. For example, a hydrogel or hydrogel composition may stimulate angiogenesis, neovascularization, adipogenesis, collagenesis, cell infiltration, tissue integration, and the like in vivo. Once injected or implanted into a soft tissue using the devices of the present invention, a combined hydrogel composition and fat material may stimulate angiogenesis, neovascularization, adipogenesis, and/or collagenesis. The hydrogel composition may comprise a hyaluronic acid component and a collagen component, for example, a hyaluronic acid component crosslinked to a collagen component.

Turning back now to FIGS. **1** and **2**, the device **10** further comprises a housing **26** configured to receive, for example, in a side-by-side manner as shown, the fat cartridge **12** and additive cartridge **18**. In some embodiments, the device may be structured such that the additive cartridge **18** is non-removable, or fixed with respect to the housing, as a means to prevent or discourage misuse of the additive.

In the shown embodiment, the fat cartridge **12** and additive cartridge **18** include luer end **27**, **28**, respectively. The housing is configured to hold two distinct, for example, different, cartridge sizes, as shown. In one embodiment, the volume ratio of fat cartridge to additive cartridge is about 2:1, up to about 5:1. For example, in the shown embodiment, the fat cartridge **12** may be sized to contain between about 5 ml to about 60 ml, or more, of material, and the additive cartridge **18** may be sized to contain between about 1 ml to about 30 ml of material. Other ratios and sizes are contemplated and are considered to be within the scope of the present invention.

The device **10** may further include a tip **30** coupled to or integral with a distal end **32** of the housing **26**. The tip **30** generally includes a lumen or chamber **36**, a proximal end for receiving and conducting into the lumen **36** the adipose tissue **14** and the additive **20**, which may be mixed or combined within the lumen **36**. The tip **30** further includes a distal end structured for receiving a cannula or needle, for example, more specifically, a needle hub. Formulation comprising a mixture of adipose tissue and additive may be passed from the tip lumen **36** into the needle or cannula **40** and thereby administered to a patient. The tip **30** includes a distal end **34** for receiving a cannula or needle **40**, for example, more specifically,

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a needle hub. The tip lumen or chamber **36** may be structured to cause mixing or combining of fat and additive as these materials are passed through the chamber **36** and into the cannula or needle **38**. Suitable needle and cannula gauges useful in the present invention include, but are not limited to, for example, 14 gauge up to 32 gauge needle/cannulas. Needle/cannulas may be blunt end or sharp.

The device **10** further comprises a plunger assembly **40** including a fat cartridge plunger **42** and an additive cartridge plunger **44**, configured to be slidably received in the fat cartridge **12** and the additive cartridge **18**, respectively, and for applying force to the contents of the respective cartridges **12**, **18** for moving the contents **14**, **20** into the tip **30** and eventually out of the cannula or needle **38** and into a patient.

In this shown embodiment, the plunger assembly **40** is a unitary structure, for example, a unitary molded structure, with proximal portion **46** providing a coupling region between fat cartridge plunger **42** and additive cartridge plunger **44**. Proximal portion **46** may be configured as a planar surface, a concave or convex surface, to accommodate a thumb of an operator of the device **10**. As shown, the plunger assembly **40** may be configured to be slidably received in the first cartridge **12** and in the second cartridge **18** and the plunger assembly **40** when actuated acting to push the adipose tissue **14**, by the action of the first cartridge plunger **42**, from the first cartridge **12** into the tip lumen **36** and to push the additive **20**, by the action of the second cartridge plunger **44**, from the second cartridge **18** into the lumen **36**, for the mixing therein.

For each fat grafting procedure, the fat cartridge **12** is filled with freshly harvested or processed adipose tissue and placed into or engaged with the housing **26**. The additive cartridge **18** is filled with an additive is also placed into the housing **26**. A housing top cover **48** is snapped over the two cartridges **12**, **18** securing them firmly in place in the housing **26**. The tip **30** is snapped onto the housing **26** using a suitable mechanism, for example, o-rings **52**, to seal fat cartridge luer end **27** and additive cartridge luer end **28** to the tip **30**.

In use, an operator loads the fat cartridge **12** containing freshly harvested and/or prepared fat, into the fat cartridge **12**. The additive cartridge **18** may already be in place in the housing **26**, or the operator engages the additive cartridge **18** with the housing **26** just prior to the procedure. The housing top cover **48** is snapped into the housing **26** which is engaged to the mixing tip **30**. The plunger assembly **40** is inserted into the cartridges **12**, **18**. The operator places the needle or cannula tip into a target region of the patient and presses the proximal portion **46** of the plunger assembly **40** to cause extrusion of fat and additive into the target region.

In some embodiments, the tip **30** may be modular in that it can be provided in a variety of different configurations allowing for a variety of mixing configurations and requirements. In some embodiments, for example, the tip **30** is configured to include mixing elements such as helical static mixers, grooves, pins, or other structure within the chamber **36** to effect mixing of the fat and additive as these are being extruded through chamber **36**.

Turning now to FIGS. **3** and **4**, another embodiment **110** of the present invention is shown.

Device **110** is similar to device **10** shown in FIGS. **1** and **2**, with a difference being that instead of housing **26**, device **110** includes open sided housing **60** which allows cartridges **12**, **18** to be installed to mixing tip **30'** by using luer thread or slip connector **64**, **66** on cartridges **12**, **18**, rather than o-ring seals. Mixing tip **30'** is similar to tip **30**, with a major distinction being that mixing tip **30'** includes coupling structure **68**, **70**

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configured to engage luer connectors **64**, **66**, respectively, of cartridges **12**, **18** rather than o-ring seals.

For example, for each surgical procedure, mixing tip **30'** is snapped onto the open-sided housing **60**. Additive cartridge **18** containing additive is inserted into the housing **60** through proximal end thereof, and is rotated until the luer feature **66** engage and tighten into the corresponding coupling structure **70** on tip **30'**. Similarly, the fat cartridge **12** can be inserted into the housing **60** and snapped or rotated in place. The fat cartridge **12** seats into the tip **30'** and uses the interference between luer end of the fat cartridge **12** and the corresponding connector **68** of tip **30'** for creating a seal therebetween. Needle or cannula **38** may be installed to the tip **30** in a usual manner.

Also shown in FIGS. **3** and **4**, is another feature different from the device **10** shown in FIGS. **1** and **2**. Rather than plunger assembly **40**, device **110** may include a plunger assembly **72** having separate, or separable, fat cartridge plunger and additive cartridge plunger **78** which include coupling structure **80**, such as a snap engagement or a slidable engagement, as shown.

Turning now to FIGS. **5** and **6**, another embodiment is shown generally at **210**. This device **210** is similar to device **110**, with a major difference being that instead of open sided housing structured for proximal end loading of cartridges **12**, **18**, device **210** includes a frame housing **88** which allows for side loading, or lateral loading, of cartridges **12**, **18**. Other features of this embodiment may be identical or similar to corresponding features of device **110** or **10**.

For example, for each surgical procedure, tip **30'** is snapped onto the housing **88**. Cartridge **18** containing additive **20** is placed into the housing **88** by either snapping the cartridge **18** straight in from the side, or by slipping the luer end **66** into side opening of housing **88**, then snapping the proximal end of cartridge **18** into the proximal end of housing **88**. The cartridge **18** may then be pressed or rotated until it tightens into the tip **30'**. The fat cartridge **12** containing adipose material **14** can then be snapped into the housing **88** in a similar manner. The fat cartridge **12** seats into the tip **30'** and uses the interference between the existing luer center protrusions of the fat cartridge and the tip **30'** for a seal. Manual pressing of the proximal end **80** of plunger assembly **72** causes extrusion of cartridge contents **14**, **20** through needle or cannula **38**.

Turning now to FIGS. **7** and **8**, another device in accordance with the invention is shown generally at **310**. Device **310** includes a plunger rod assembly **90** having structure for allowing variations in the quantity of harvested adipose material **14**. For example, plunger rod assembly **90** may include a fat cartridge plunger rod **98**, an additive plunger rod **94**, and a variable position plunger rod/thumb piece **92** designed to lock the plunger rods **98**, **94** together in variable positions. In the shown embodiment, the thumb piece **92** is pivotally coupled to additive plunger rod **94**, and engageable with a corresponding fat cartridge plunger proximal portion **96** of fat cartridge plunger rod **98**. The fat cartridge plunger rod **98** may be moved to a desired position and the thumb piece **92** may be then engaged to (e.g. snapped onto) the fat cartridge plunger proximal portion **96**, thus fixing the fat cartridge plunger rod **98** and additive cartridge plunger rod **94** in place with respect to each other. This arrangement allows a desired volume injection ratio of fat to additive as the plunger assembly **90** to be maintained while thumb piece **92** is depressed and plunger rods **94**, **98** move in unison through cartridges **12**, **28**. (FIG. **8**).

Turning now to FIG. **9**, it is contemplated that different tips, for example, tips **30a**, **30b**, and **30c**, may be provided on the device **10** (or **110**, **210** or **310**) of the invention for providing

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different extrusion/mixing results. Each of these tips **30a**, **30b** and **30c** may serve unique benefits, such as improved vascularization of the fat, decreased extrusion force (for usability), as may be beneficial for different applications on the body.

For example, tip **30a** may be provided which includes suitable structure effective to mix or combine the fat material **1** with the additive **2** as these materials **1**, **2** are passed through tip **30a** immediately prior to extrusion from needle or cannula **38**. Alternatively, tip **30b** may be provided which is structured to extrude fat material **1** and additive **2** without substantial or significant mixing. Alternatively still, tip **30c** may be provided which is structured to provide a co-extrusion of fat material **1** and additive **2**, as shown. Although not shown, it can be appreciated that tip **30c** may be configured to provide a coextrusion with fat **1** surrounded by additive **2**, rather than as shown (additive **2** surrounded by fat **1**).

Other tips and structure useful as components of the present devices **10**, **110**, **210**, **310** are disclosed in U.S. patent application Ser. No. 12/909,216, filed on Oct. 21, 2010, and entitled DUAL CARTRIDGE MIXER SYRINGE, the entire disclosure of which is incorporated herein by this specific reference.

In another aspect of the invention, the device **10**, **110**, **210**, **310** may include a mechanism for discouraging or preventing tampering or misuse of product.

For example, as mentioned hereinabove, the additive cartridge may be permanently fixed in the housing to prevent removal without destruction of the device.

Alternatively or additionally, as illustrated in FIG. **10**, a feature may be provided which reduces, eliminates or prevents a user from extruding or removing the additive from the device, without also extruding fat material therewith.

For example, the tip **30** or **30'** may be provided with a valve **104**. Valve **104** includes geometry that allows opening of the additive injection channel only when engineered pressures are induced. Typically air, a highly compressive medium is unable to create a sufficient spike in pressure to rotate the valve and allow dispensing of additive. Alternatively, a medium like fat, a non-compressive medium, is able to create the pressure spike and rotate the valve for additive injection. In other embodiments, the valve could involve flaps, diaphragms, pinches, or other means to achieve the same function. Valve **104** is structured to remain sealed or closed in the event that only air pressure is applied to the fat cartridge valve seat. Thus, the valve **104** would prevent dispensing of additive alone.

While this invention has been described with respect to various specific examples and embodiments, it is to be understood that the invention is not limited thereto and that it can be variously practiced within the scope of the invention.

What is claimed is:

1. A device for introducing into a target region of a patient, a combination of adipose tissue and an additive, the device comprising:

- a fat cartridge;
- an additive cartridge;
- a housing configured to receive, in a side-by-side manner, the fat cartridge and additive cartridge;
- a mixing tip on the housing, the mixing tip including a distal end for receiving a cannula or needle;
- a plunger assembly slidably received in the fat cartridge and the additive cartridge, the assembly including a fat cartridge plunger rod and an additive cartridge plunger rod;
- a thumb piece structured to fix the fat cartridge plunger rod and the additive cartridge plunger rod in place, in variable positions, with respect to each other; and

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a valve structured to prevent extrusion of additive from the additive cartridge without extrusion of fat from the fat cartridge.

2. The device of claim 1 wherein the thumb piece is structured to be snapped onto the fat cartridge plunger rod.

3. The device of claim 1 wherein the housing is configured to receive the fat cartridge and the additive cartridge in a longitudinally slidable manner.

4. The device of claim 1 wherein the housing is configured to receive the fat cartridge and the additive cartridge in a lateral manner.

5. The device of claim 1 wherein the additive cartridge contains an additive.

6. The device of claim 5 wherein the additive comprises hyaluronic acid and collagen.

7. The device of claim 5 wherein the additive comprises hyaluronic acid crosslinked with collagen.

8. A device for introducing into a target region of a patient, a combination of adipose tissue and an additive, the device comprising:

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a fat cartridge;

an additive cartridge including an additive;

a housing configured to receive, in a side-by-side manner, the fat cartridge and additive cartridge;

a mixing tip on the housing, the mixing tip including a distal end for receiving a cannula or needle;

a plunger assembly slidably received in the fat cartridge and the additive cartridge, the assembly including a fat cartridge plunger rod and an additive cartridge plunger rod;

a thumb piece structured to fix the fat cartridge plunger rod and the additive cartridge plunger rod in place, in variable positions, with respect to each other; and

a valve structured to prevent extrusion of additive from the additive cartridge without coextrusion of fat from the fat cartridge.

9. The device of claim 8 wherein the additive comprises hyaluronic acid crosslinked with collagen.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,095,654 B2
APPLICATION NO. : 13/966953
DATED : August 4, 2015
INVENTOR(S) : Justin Schwab et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, item (56)

On the Page 2, in column 2, under "Other Publications", line 3, delete "Publishiers" and insert
-- Publishers --, therefor.

On the Page 2, in column 2, under "Other Publications", line 6, delete "dermall" and insert
-- dermal --, therefor.

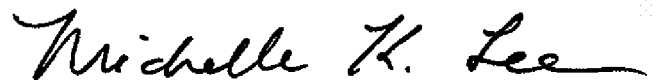
In the Specification

In column 3, line 1, delete "tissue" and insert -- tissue 14 --, therefor.

In column 3, line 46-47, delete "housing" and insert -- housing 26 --, therefor.

In column 5, line 19, delete "plunger and" and insert -- plunger 76 and --, therefor.

Signed and Sealed this
Fifteenth Day of March, 2016



Michelle K. Lee
Director of the United States Patent and Trademark Office